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AN EXPEDITION TO THE NORTHERN MAGNETIC POLE.

A DISCUSSION BEFORE THE AMERICAN GEOGRAPHICAL SOCIETY, MAY 2, 1892.

The meeting was opened at 8.15 P.M.

Chief Justice Daly, President of the Society, said: The meeting this evening is to be devoted exclusively to the consideration of a proposed expedition for the exploration of the region immediately around the North Magnetic Pole, a subject which it is especially appropriate for a geographical society to consider, as the investigation and increase of our knowledge of terrestrial magnetism is one of the objects for which such societies have been founded. Such an expedition has, at least, this to recommend it, that the North Magnetic Pole can be reached and the portion of the Arctic immediately about it, or in its vicinity, can be traversed, whereas the Southern Magnetic Pole lies in an ice-bound region which man has not penetrated and perhaps never will penetrate.

The idea of this expedition was suggested two years ago by Colonel Gilder, in respect to whom it is appropriate that I should say a few words. Colonel Gilder is a distinguished officer of our war for the preservation of the Union, who served throughout the whole of that war in three army corps. A few years after his return, that is, in 1879, he volunteered to go in the expedition sent out by this Society in that year, called the Franklin Search Expedition, to discover the diary and papers of Captain Franklin, which, it was supposed from information which the Society had received, might possibly be discovered in a certain part of the Arctic. Though the expedition did not accomplish the object for which it was sent out, it was at least successful in the large amount of accurate information that was obtained respecting the region traversed by its members. During this expedition Colonel Gilder performed the longest sledge journey upon record.

He has the advantage, moreover, of having been in sight of the locality where Sir James Ross, in 1831, found the North Magnetic Pole; that is to say, he was on that extreme portion of King William's Land known as Cape Felix, and in front of him, or east, say about twenty miles distant, was Cape Adelaide, where, as I have said, the Pole was discovered by Sir James Ross sixty-one years ago. Afterward, in 1881, he went as a volunteer, in the "Rodgers," a vessel fitted out by our Government to search for the "Jeannette" and the lamented Captain De Long, and in that expedition he performed a remarkable journey over the whole of Siberia, occupying a period of five months and embracing a journey of 6000 miles, which he made alone, with no aid except that of the natives. I mention these instances because he is a most appropriate person, from his experience as an explorer, to lead an expedition for the survey of the region immediately around the North Magnetic Pole, the scientific part of which survey will be the work of the specialists that may go in the expedition.

I shall not, by any remarks of my own, anticipate what will be more appropriately said by the distinguished gentlemen that are to speak to-night, who are magnetists and authorities upon all questions of terrestrial magnetism, in respect to the utility and value of such an exploration. It is sufficient to say that we owe to the Chinese, I think about eleven hundred years before the beginning of our era, the discovery of the polarity of the needle, and that it is to the introduction of the compass in Europe, through that discovery, that certain portions of the globe were reached by water which never would have been reached without the aid of that instrument. It is to its aid that we owe the crossing of the Atlantic, then called the Sea of Darkness, by Columbus, and the discovery of America. Everything, therefore, which adds to what we know of the variation of the compass and the cause of it ; in fact everything that increases our knowledge of the phenomenon that we call terrestrial magnetism is of the greatest interest to mankind. How far the proposed expedition will or may lead to information of that nature you will hear from the gentlemen who are now to address you.

I regret that two of the gentlemen that we expected here to-night will not be present. Professor Mendenhall is unable to come, but sends us a letter which I will read to you, and also one from Professor Marsh, President of the Academy of Sciences at Washington ; both of whom are in favor of sending out an expedition of this nature.

The letter I read is addressed to Colonel Gilder by Mr. Mendenhall.

UNITED STATES COAST AND GEODETIC SURVEY,
WASHINGTON, D. C., April 30, 1892.

MR. W. H. GILDER, 40 Wall St., New York City.

Dear Sir: I regret very much that official duties which cannot be postponed will prevent my being present at the meeting on Monday night, as I had hoped to be up to a recent hour. I am much interested, both personally and officially, in the subject which will engage the attention of the Geographical Society on that occasion, and I would have been glad to aid in any way the development of a plan for accomplishing what all well-informed people must regard as an important work. In order that Judge Daly (to whom you may show this letter if you think it desirable), may understand the relation of the Coast and Geodetic Survey to the proposed scheme up to the present time, I will briefly recount events bearing upon it during the past few years.

About two years ago you called upon me and suggested the desirability of an expedition to the region of the North Magnetic Pole. You asked what assistance, if any, in the way of observers and instruments, could be furnished by the Survey, and expressed your willingness to take charge of such an expedition. You also stated that you believed that a sufficient sum of money to defray the expenses of such an expedition could be obtained by voluntary contributions. In reply I declared my belief in the importance and desirability of such an investigation, and stated that under certain conditions the Coast and Geodetic Survey might be able to detail a skilled officer for conducting the magnetic survey, provided his expenses could be paid. I brought you into conference with Mr. Schott, the first authority in the country on this subject, and also suggested that the subject seemed to me of sufficient importance to justify asking the advice and coöperation of the National Academy of Sciences. At my request the Secretary of the Treasury sent a communication to the President of the Academy, asking that body to advise the Government as to the best methods of securing the desired end. A committee was appointed by the President of the Academy, and the subject has been under consideration by this committee for a year or more.

In the meantime you have assured me that you have renewed assurances of contributions, and excellent prospects of securing an ample fund for carrying out the exploration in a manner such as to insure success.

The information to be gained by such an expedition is important for several reasons. The determination of the location of the Magnetic Pole would be of great service in the development of the general laws of terrestrial magnetism, a subject of which we, as yet, know comparatively little, notwithstanding the many years devoted to its investigation by many able men. A secular change in the position of this Pole has been assumed in more than one theory of the earth's magnetism, and if such motion exists, it can only be determined by positive observation at dates sufficiently separated from each other. During the past few years much light has been thrown upon the curious and interesting relation now known to exist between solar activity and terrestrial magnetism.

An exploration of the kind proposed might contribute facts of great value as bearing on the question of solar influences, and might hasten the day on which a satisfactory explanation of these influences shall be possible.

It is not necessary to enlarge upon a proposition which speaks so well in its own behalf, and I will only remark in conclusion that an expedition to the region of the Magnetic Pole, if adequately equipped and well organized, cannot fail to be of great and lasting value to science.

As ever, yours faithfully,
T. C. MENDENHALL,
Superintendent.

Professor Marsh, the President of the Academy of Sciences, merely writes a brief note, enclosing the preliminary report of the National Academy of Sciences.

NEW HAVEN, CONN., April 29, 1892.

W. H. GILDER, ESQ.

Dear Sir: I have received your letter of yesterday, and regret that an engagement here will prevent my attending the meeting of the American Geographical Society on Monday next.

In accordance with your request, I will, with pleasure, send to Judge Daly a copy of the official correspondence between the Treasury Department and the National Academy of Sciences, relating to the investigation of the North Magnetic Pole, and the preliminary report of the committee of the Academy on this subject.

Wishing all success to the plan proposed,

I remain, yours, very truly,
O. C. MARSH.

PRELIMINARY REPORT OF THE INVESTIGATION OF THE NORTH MAGNETIC POLE.

(Correspondence.)

THE NATIONAL ACADEMY OF SCIENCES,
WASHINGTON, D. C., January 8, 1891.

Sir: I have the honor to transmit to you, herewith, a preliminary report made by a committee of the National Academy of Sciences, in accordance with a request contained in your communication of May 22, 1890. The questions relating to the North Magnetic Pole thus submitted to the Academy require more time for examination than was at first expected; but the investigation is still in progress, and I trust I may be able to transmit to you the complete report at an early day.

Very respectfully,
O. C. MARSH,
President of the National Academy of Sciences.

The SECRETARY OF THE TREASURY.

TREASURY DEPARTMENT, May 22, 1890.

Sir: I have the honor to forward herewith a copy of a letter from the Superintendent of the Coast and Geodetic Survey, of April 28, 1890, containing a request for the appointment by you of a committee composed of members of the National Academy of Sciences, or others familiar with the problems involved, to formulate a plan or scheme for a systematic search for the North Magnetic Pole.

As this Department may be called upon, through the Coast and Geodetic Survey, to aid in an exploration of the region containing this Pole, and in view of the fact that the organic act under which the Academy exists declares that it shall, whenever called upon by any department of the Government, report upon any subject of science or art, I respectfully request the appointment of a committee which shall make report as desired in the letter herewith.

Respectfully yours,
GEO. L. BATCHELLER,
Acting Secretary.

Prof. O. C. MARSH,
President National Academy of Sciences,
New Haven, Conn.

UNITED STATES COAST AND GEODETIC SURVEY,
WASHINGTON, D. C., April 28, 1890.

Sir: The importance of a re-determination of the geographical position of the North Magnetic Pole has long been recognized by all interested in the theory of the earth's magnetism or its application. The point as determined by Ross in the early part of this century was not located with that degree of accuracy which modern science demands and permits, and besides it is altogether likely that its position is not a fixed one. Our knowledge of the secular variation of the magnetic needle would be greatly increased by better information concerning this Magnetic Pole, and in my judgment, it would be the duty of the Government to offer all possible encouragement to any suitably organized exploring expedition which might undertake to seek for this information. I am informed that such an expedition is now contemplated, and in order that such coöperation and encouragement as may be deemed advisable on the part of the Coast and Geodetic Survey may lead to the best possible results, I respectfully request that you communicate with the President of the National Academy of Sciences and ask that a committee composed of members of that body, or others who are familiar with the difficult problems involved, be appointed to formulate a plan or scheme for carrying out a systematic search for the North Magnetic Pole, in accordance with which the Survey might render such assistance as may be considered possible and desirable.

I am respectfully yours,
T. C. MENDENHALL,
Superintendent.

The SECRETARY OF THE TREASURY.

YALE UNIVERSITY,
NEW HAVEN, CONN., June 16, 1890.

Sir: I have the honor to acknowledge the receipt of your communication of May 22, 1890, containing a request for the appointment of a committee composed of members of the National Academy of Sciences, or others familiar with the problems involved, to formulate a plan for a systematic investigation of the North Magnetic Pole. A letter from the Superintendent of the Coast and Geodetic Survey, dated April 28, 1890, explaining more fully the object of the proposed exploration, was inclosed with your communication.

In reply, I have the honor to inform you that, in accordance with this request, I have appointed the following committee:

Prof. S. P. Langley, Secretary, Smithsonian Institution, *Chairman.*

Gen. Henry L. Abbot, U. S. Army.

Prof. William P. Trowbridge, Columbia College.
Prof. Alfred M. Mayer, Stevens Institute.
Prof. Chas. A. Schott, U. S. Coast and Geodetic Survey.
Prof. John Trowbridge, Harvard University.
Prof. Charles Carpmael, University of Toronto.

The members of this committee are all familiar with the important questions to be solved, and will give the subject careful consideration.

Very respectfully,
O. C. MARSH,
President, National Academy of Sciences.

The SECRETARY OF THE TREASURY.

PRELIMINARY REPORT.

BOSTON, November 12, 1890.

Sir: Referring to your letter of the 16th of June and to its inclosure of a letter from the Secretary of the Treasury requesting the appointment of a committee to formulate a plan for the investigation of the Magnetic North Pole; and also inclosing a letter from the Superintendent of the Coast and Geodetic Survey; I have the honor to state that the committee has met, and that, having laid before them the communication in question, they have instructed me to report as follows:

The committee wish to state that, in their opinion, a knowledge of the exact position of the Magnetic North Pole is not so desirable as a study of the changes in the magnetic elements to be obtained from a cordon of stations, stretching from Alaska to Newfoundland, supplemented also by stations in Siberia, which might be established by the Russian Government in connection with the United States Government.

Since, however, the language of the communications before the committee restricts the question to the best method of determining the exact position of the Magnetic North Pole, they feel that more definite information in regard to the nature of the country in the region to be investigated should be laid before them. They believe that this information can best be obtained from those who have visited the region in question, and that the committee at present can merely make general suggestions, recommending the occupation of a cordon of stations in the neighborhood of the line of dip of 89°; for instance, on Prince of Wales Land, Boothia, near Point Ogle, and on the west side of Victoria Straits.

The committee, however, wish to emphatically state that they only recommend the above stations if they prove accessible. They have no information as to their accessibility, and they therefore express no opinion upon this point.

They desire to state that, in their opinion, whatever points are occupied, or whatever system is adopted, it is of importance to secure simultaneous observations at all the stations; and further that the character of the apparatus to be employed is of such consequence that the committee reserve the discussion of it for a later and more deliberate report.

Your obedient servant,

S. P. LANGLEY,
Chairman.

Prof. O. C. MARSH.
President of the National Academy of Sciences.

Judge Daly then added:

We have, however, present to-night, ladies and gentlemen, three distinguished gentlemen, Professor Trowbridge, Professor Mayer and General Greely. You have welcomed General Greely here before, on his return from his expedition, and it will be gratifying to you all to see him here again to-night.

It gives me very great pleasure to introduce Professor Trowbridge, of Columbia College.

Professor Trowbridge spoke as follows:

Ladies and Gentlemen: The interest that is to be taken in the proposed expedition for finding the present position of the North Magnetic Pole of the earth is not to be restricted to the question whether the Pole be a fixed or a moving point. There is a greater and larger view under which the matter may be considered. The terrestrial phenomena connected with heat, electricity and magnetism, you all know, are uppermost in the minds of all. Everything connected with these subjects is now of the greatest importance to the development and well-being of the human race, inasmuch as they appear to be the primary causes which affect or control nearly all phenomena connected with active terrestrial physics.

This mysterious force of magnetism is at least the evidence of one of the agents, one of the causes, and we know not whether as an electrical phenomenon it may not be connected with the prime cause that initiates our storms, that influences even our vital energies, and controls, indirectly, many conditions necessary to life upon the earth. We know what advances have been made in our knowledge of electricity and this expedition cannot fail further to extend that knowledge.

Now let us see what is our present knowledge of the magnetic force of the earth in regard to the direction which it causes a magnet to assume in reference to the true terrestrial north and south. It is interesting just at this time to know that Columbus was the first to discover in his first voyage across the Atlantic that on one side of a certain line along which he sailed, the magnet pointed to the west of the true astronomical or terrestrial meridian; and on the other side of this line, it pointed to the east of the true north several degrees. He followed that line of no variation for several degrees. It has been found by subsequent observations, and some of those observations at a single place have extended through several centuries (in Paris nearly five centuries), that the magnetic needle in most places not only does not point to the true north, but its direction never remains stationary in one place. If we take the City of New York, for instance, in 1795 the magnetic needle pointed 8° to the west of the true terrestrial north. It then began a movement to the east, which it reached about 1810, reducing this angle—this westerly angle—about 4°. It then commenced to go back, and it is now going back to its original position and points nearly 8° again west of north.

If you were to go to the west of a line passing through the City of Charleston and extending in a northwest direction irregularly to the Straits of Mackinac, for instance, you would find that this variation is east of north at all points in the United States west of this line, and west of north at all places east of this line at the present time. During a period of several centuries, however, the magnet at any place swings like a pendulum, in one direction and then back, always pointing away from the true north—at some places more than 20°, on one side of the line of no variation to the west, and on the other to the east. Think of this fact—a movement forward and back which requires several centuries for its accomplishment. What are the causes of this great secular movement? We cannot fathom them now, but we are looking for them and trying to find them out. This secular variation is accompanied by many others. As the magnet approaches its mean position, its secular motion is more rapid; when it reaches its eastern or western elongation it seems to rest for several years. Places to the east of a certain magnetic line, you will remember, have a variation or declination, as it is called, to the west, and places to the west of the same line a like declination to the east. That magnetic line in the United States, in 1795, passed near Washington and Toronto. In 1875 it passed near Wilmington, North Carolina, and Detroit; it now passes near Charleston and the Straits of Mackinac. Along that line a man travelling with a compass would find it pointing directly to the terrestrial north. This line of no variation, moving to the westward, and the grand secular variation, point us to the fact that there must be some corresponding movement of the North Magnetic Pole. But it is not the finding of that Pole which is of the greatest interest. It is the law which governs these great movements that is the ultimate object sought.

In connection with this great swinging of the magnet from west to east, and back again, requiring several hundred years for a complete cycle, there is an annual variation very similar but very small. In connection with that there is a daily variation. Every morning throughout the northern hemisphere, as the sun rises, the north end of the magnet moves to the westward, and at about one o'clock it begins to return; toward nightfall it gets nearly back, and before the next morning it gets back again to its first position. This is known as the diurnal variation of declination The extent of this solar diurnal variation seems to depend upon the sun, and is influenced by the spots upon the sun. When there is a minimum number of spots these variations in extent are a minimum; when there is a maximum number of spots, the variations reach a maximum. There are also variations depending upon the rotations of the sun and moon.

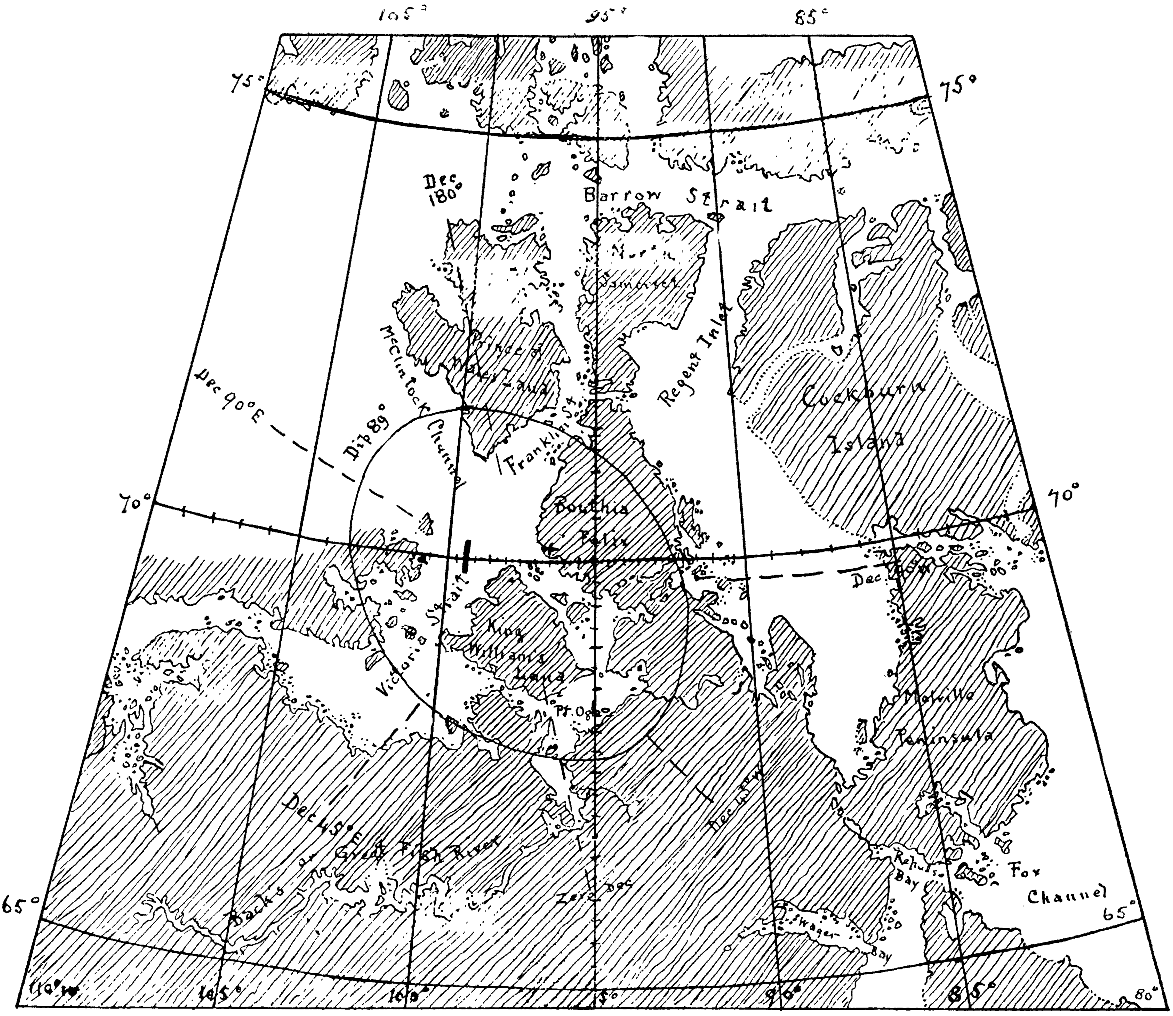
You may ask, what is the use of the knowledge to be gained by this expedition? This is a very proper question, although it may be assumed that all new discoveries which extend our knowledge of nature and nature's laws are useful, either intellectually and morally, or in the practical bearings which they have upon the material progress and the welfare and well being of the human race. The answer in this case, however, may be, I think, more specific. We are living in an epoch of the world's history when man is struggling for a higher and more perfect life, not only against the degrading tendencies of his inherited nature, but to make the forces of nature subservient to his advancement and well being. Among these forces there are none which seem to affect or control the conditions of animal life on the earth more than heat, light, electricity and magnetism, all, perhaps, the manifestations of one cosmical agent. As the variations of the magnetic force appear to follow lesser and greater cycles, it is not impossible that nearly all terrestrial phenomena, which depend on causes allied to magnetism, follow similar cycles. We can now predict the course of storms ; may we not hope to determine their origin, and predict their recurrence, as far as they may depend upon the forces which have been mentioned ? A knowledge of the laws of the cycles through which these forces pass is the first and only step in this direction to be taken, and this step must be made by patient, long-continued observations.

As to questions of actual utility in a knowledge of terrestrial magnetism, we know that a ship at sea cannot, in a fog or storm, safely sail without a magnet. It is true that if the sun comes out the latitude may be determined, and the longitude may be kept up by chronometers ; but a ship cannot sail from port to port without a magnet, and it is important to have all these variations, which have been mentioned, determined and predicted for years in advance and put upon sailing charts. Therefore as a mere matter of utility this whole question of magnetic variations and the determination of the poles will add to our knowledge very greatly. I will not refer particularly to the value of the magnet on land, only to say that I think, by law, all magnetic surveys upon land should be prohibited. With these constant variations, there is no telling from one day to another what direction the needle may have. I have not referred to magnetic storms ; yet what are called magnetic storms may cause a sudden variation of the magnet of such magnitude as to cause serious errors and to vitiate the work of the best surveyors.

Explorations at the North Pole were originally started with a view to finding a north-west passage for commercial purposes. It was found very soon that the idea was impracticable, and yet explorations were continued. They were continued from time to time merely to point out and discover the northern geographical boundaries of our continent. Incidentally, too, scientific questions of great value came up and were solved, or, at least, facts were gained toward solution. Nowadays, however, it has become rather the duty of men of science, since the northern regions have been pretty well explored, to devote themselves to specific problems, and that which is proposed here to-night is one, the problem of finding the exact place of the North Magnetic Pole of the earth ; and when a gentleman comes forward to volunteer his services for this purpose, we ought to give heed to his aims and objects. During the early days of my life, I made a sort of magnetic exploration of the western coast of the United States, and afterward erected a self-registering magnetic observatory at Key West, Florida; but I confess the thought never came into my mind to banish myself from civilization and society and to go to the North Pole in pursuit of this science ; and when we see a man ready to do that and to volunteer to undergo the dangers and risks for any scientific purpose, I think he ought to be highly encouraged.

I have here to-night, perhaps it is hardly necessary for me to read it through, a letter from Professor Schott, whose name has been mentioned and who is probably the best informed on all the details of terrestrial magnetism of all men in this or any other country. This letter embodies the details of what he considers it desirable to do in this expedition. He was a member of the commission alluded to, appointed by the President of the National Academy, at the request of the Secretary of the Treasury, and I am in receipt of Mr. Schott's letter through the late president of the commission. Perhaps this letter will give us an idea of the work to be performed, and the nature of the expedition to the North Pole. And I repeat that when we find these rare men, ready to go to the North Pole and sacrifice their lives, if necessary, to banish themselves from social comforts in behalf of science, I think that we ought to regard them as true heroes and aid them in every way.

I believe that the cost of this expedition, according to Colonel Gilder, will be less than has ever been expended for a scientific expedition to the North Pole where such great results are promised. Fortunately, the probable position of the Pole is comparatively easy to reach, and I look forward to the day when there will be telegraphic communication with those lands; where observers may remain all winter and where telegraphic stations, extending from New York to Hudson Bay, will enable them to procure needed supplies, and where observers may continue their studies. These observations may be the beginning of a series of observations which will result in our ascertaining to some extent the true nature of the wonderful phenomena of magnetism and electricity in connection with the earth



MAP TO ILLUSTRATE A PLAN FOR A MAGNETIC SURVEY OF THE REGION IMMEDIATELY SURROUNDING THE NORTHERN MAGNETIC POLE.

[Copy, April 21, 1891.]

WASHINGTON, D. C., October 21, 1890.

PROFESSOR S. P. LANGLEY,
Secretary Smithsonian Institution.

Dear Sir: In response to a letter of June 16, 1890, of the President of the National Academy of Sciences, appointing me a member of the committee of which you are chairman, I have the honor to submit herewith a paper on a plan for a magnetic survey of the region immediately surrounding the Magnetic Pole.

I remain, sir, yours respectfully,
CHAS. A. SCHOTT.

REMARKS RESPECTING THE STATE OF OUR KNOWLEDGE OF THE POSITION OF THE MAGNETIC POLE IN THE NORTHERN HEMISPHERE.

Among the questions in the study of terrestrial magnetism there is one of paramount interest—namely, that referring to the position of the poles. It is well known that the one in the northern hemisphere was located with some precision more than half a century ago, but no definite measures have since been taken, either to verify the position or to ascertain whether it persists in that locality or changes its place conformably to the secular variation, as noticed in surrounding regions. There does not appear to be any special theoretical reason for supposing that the poles are either stationary or in motion, and certainly there is no other way of solving the question, except by actually repeating the practical interrogation of nature and trying by observation to locate the present whereabouts of the Pole geographically nearest to us; the other, in the southern hemisphere, being situated beyond an oceanic region, has remained hitherto inaccessible.

At every point on the earth's surface, where magnetic observations have been made for a sufficient length of time, it is found that the three elements, under which, for the sake of convenience of discussion, the magnetic force is generally considered, are in a state of slow, progressive motion, denominated secular variation. As the name implies, it extends over centuries and is probably of a periodic nature; its cause, however, is as yet entirely unknown. The general surface distribution of magnetism is, in consequence, ever changing in time, and why should the Pole not partake of this movement, though the phenomenon is subject to modification from place to place? This is an argument of those who hold that the Pole is ever shifting its place, according to a fixed law. On the other hand, the position of the direction of the axis of a magnetic body may yet be a persistent feature, though the magnetic intensity upon the whole may change. Dealing with surface distribution, and remembering that the magnetic force at any place depends on the total magnetization of the body, it seems more probable that the Pole has no immunity from the general law of change than that it remains fixed. While some magnetists hold the idea of a large motion even to the extent of carrying, in time, the magnetic around the geographical Pole, and have assigned to it a period of great length, and have actually delineated the orbit or looped path, there are others of less extravagant or better-supported opinion, who would allow but a much more limited motion. Looking at recent iso-magnetic charts, such as those published by the

English Admiralty and the German Marine Observatory, the Pole occupies a position still quite close to where it was found in 1831, but this circumstance may be simply explained by our want of knowledge where else to place it. We here approach the practical part of the question relating to navigation. Sometimes confusion has arisen from want of discrimination of properties, respecting the number of poles existing, and it may not be deemed out of place here to state that this paper has no concern with the two foci of maximum total intensity of magnetic force found in the northern hemisphere, and which should never have been termed poles. The American focus of intensity lies to the south of Hudson Bay, between it and Lake Superior, and is the stronger one of the two. At the Pole, properly so-called, there is a coincidence in gravitational and magnetic forces; hence the horizontal component of the latter, as well as the declination, vanish, and the dip becomes 90°; the total intensity, identical with the vertical component, is estimated to be at present not far from 0.62 of a dyne.

The first definite location of the Pole is due to Sir James Ross, who, in the spring of 1831, found himself in a place on the shores of Boothia where the dip was 89° 41′, and the declination 57° W., whence he concluded that the Pole should lie in that direction at a distance of about thirty-five miles. He reached the calculated position June 1st, in latitude 70° 05.′3 and in longitude 96° 45.′8 W. Here the dip was 89° 59′, and no difference sufficient to point out a magnetic meridian could be perceived in the times of oscillation of the needle in various azimuthal planes. This place is marked by a star on the accompanying map. The locality was approached from the south by Captain Back, when, on August 12, 1833, at Point Ogle, north of the Great Fish River, in latitude 68° 14′ and in longitude 94° 58′ W., he observed the dip 89° 24.′2 which, in a measure, confirms the position previously found. A third important determination of dip in this vicinity, though at a greater distance, but at a later date, is that of Sir Francis Leopold McClintock, at Fort Kennedy, Bellot Strait, in latitude 72° 00.′8 and in longitude 94° 19′ W. Here, in 1858, the dip was 88° 27.′4 and the declination 135° 47′ W., and the latter quantity would seem to indicate that in the meantime the Pole had moved farther to the westward. Thus the oval-marked dip, 89°, on the map, and which was taken from a paper by Captain Evans, hydrographer to the Admiralty, and supposed to answer for the year 1875, has its centre somewhat to the west and south of the position marked by the star. As a piece of useful knowledge to an explorer, it may be stated that a change of 1′ in the dip will roughly correspond to a change of distance of about two statute miles in a direction at right angles to the oval and inwards. The latest information we have is by Lieut. F. Schwatka (*Science*, of Feb., 1885), who visited King William Land in 1879–80. He places the Pole in longitude 99° 35′, as marked on the map by a heavy vertical dash, or about sixty-five nautical miles due west of Ross's position, but retaining the latitude given by Ross; his reasons for placing the Pole, in 1879, so far westward, are given in the article referred to. He says: "When at Cape Felix, the most northern point of King William Land, the needle (of an extremely delicate compass) remained sluggishly in almost any position that was given it; when pointed in a N. E. and S. W. direction, I thought I detected a slight tendency to move to the westward." At Franklin Point, about thirty-five statute miles south and west (true) of Cape Felix, the needle showed a little activity at longitude 99°; near Point Little, about twenty statute miles east of Cape Crozier (the western cape of King William Land), "I took the largest and most careful series of observations, and the needle always returned to within 18° of the Pole as I have located it. . . ." According to Lieut. Schwatka's firm belief, the position of the Magnetic Pole in 1879 was between longitude 99° and 100°, but with its latitude undetermined. From what has been stated it would appear probable that the present (1890) position of the Pole lies to the westward of King William Land somewhere in Victoria Strait; hence it will be necessary for the explorer to be prepared to cross that channel and extend his magnetic survey to Victoria Land. It is desirable that Ross's station be revisited.

MODE OF APPROACH TO THE MAGNETIC POLE.

Suppose the observer ready to start from his landing place or camp after he has attended to the necessary magnetic observations, as mentioned in detail further on, he may first direct his course towards the western shore of King William Land by the best route in his judgment. Magnetic stations should at first be made at long intervals, say 50 miles apart, in order not to impede the progress of the party while on ground yet outside its more important field of research; afterwards, when approaching a dip of 89° they should be located closer together, say at distances of 30 or 20 miles, according to circumstances. Before that isoclinic curve is reached, the explorer will know by the direction of the magnetic meridian, as shown by his azimuth compass or declinometer, whether or not his steps are likely to carry him too far to the east or to the west, and he will be guided accordingly. The magnetic meridian thus pointed out at a station is a tangent to the curve, but as the curvature is small, and, moreover, every additional station gives a new direction, he may follow it as far as desirable or practicable. Lines drawn in the direction of the magnetic meridian from a number of stations where the dip exceeds 89°, will fairly meet in points covering a sufficiently defined area, the central part of which may be taken to include the place of the Pole.

To estimate the distance from it, the observer may take the difference in minutes of arc, between dip 90° and his observed dip, and allow from 1¼ to 2 statute miles of distance for each minute of dip. In this rough way the observer can gain a fair knowledge of the position of the Pole.

PHYSICAL CONDITIONS IN THE VICINITY OF THE POLE.

An observer who should expect to plant his dip-circle right over the Magnetic Pole would likely be disappointed, on account of local irregularities in the distribution of magnetism, which may indicate the possible presence of more than one spot with dip 90°. Such irregularities are met with even in localities where the surface strata would apparently give no indication to suspect local disturbance, but they are largely developed over regions abounding in igneous rocks and, in particular, near great faults, and in basaltic formations, and in localities of trap-dykes, no matter whether they crop to the surface or are concealed below. Within that limited region where the explorer expects to find the Pole, he should multiply his stations by distributing them over a number of square miles, and thus provide the means for developing and exhibiting the local peculiarities of the limited area. From it, as a centre, a few lines should be run outward so as to secure half a dozen or more stations *completely surrounding* the area at a distance of a few miles. It is, of course, about an equal chance that the Pole is located over a land or a water area, and it may be impossible of exact fixation in position either by reason of inaccessibility through ruggedness, or by reason of being water-covered, or from instability of ice. Nevertheless, the object of the expedition would be completely gained if observations were secured at a sufficient number of stations so located as to *surround*, as near as may be, the place of the Pole, though no one observation may reach within ¼° of vertical dip. It is clear that the point is gained, if we have the means of satisfactorily locating the isoclinic curves of (say) 89° 30′, 89° 40′, and 89° 50′.

TIME REQUIRED FOR THE RESEARCH.

This will depend in a measure on the strength of the organization and on the accessibility of the Polar region. Owing to the shortness of the season when travelling is practicable, whether by sledge or boat, or by both, a single observer would certainly need two seasons, and even two observers would have no time to spare when aiming at a complete magnetic survey. It would seem desirable for other reasons that two observers take part in the work, to guard to some extent against interruption through sickness or against accidents to instruments. At all events the party must be prepared to spend two winters in this region.

DETERMINATION OF GEOGRAPHICAL POSITIONS.

The observations for positions of the magnetic stations should be regarded as of equal importance with the magnetic measures, since without reliable positions the latter could not be properly utilized; besides they will furnish the means for improving existing maps and will form the basis for the delineation of any new topographical features the survey may develop. It is recommended that the latitude and longitude of some place of the route should be observed daily, weather permitting, and that a record be kept of the direction of travel and of distances estimated, so as to bind the observing stations together and assign to them their geographical co-ordinates. It is recommended that observations of circummeridian altitudes of the sun be taken for latitude, and observations of equal altitudes of the same object be made for longitude, the latter to be differentially reckoned from the landing place, starting point or winter quarters, as the case may be. Time will be kept by two pocket chronometers to be carried on the person of the observer for the better preservation of uniform rate, as they will then be least exposed to variations of temperature. The dates should be noted according to civil reckoning and the hours should either be recorded from 0 to 24, or to any time set down there should be added A.M. or P.M., as the case may be. A time-piece with face graduated to 24 hours should be procured preferably to one of the usual pattern, since records from the latter, not infrequently, are a source of doubt or annoyance to the computer in the determination of rates, unless in the use of 12 hours twice over the record is accompanied by a proper sign. The sun may be observed for azimuth at any time of the day, the chronometer correction for local time being known as well as the latitude of the place. Observations for time are made most advantageously when the sun is in or near the prime vertical, but they should not be taken within an hour and a half from noon. A small altazimuth with circles of 10 or 13cm. (4 to 5 inches) diameter, such as frequently form part of a magnetometer, will suffice for the determination of these geographical positions. With an instrument of this size the latitude can readily be fixed within 1′ of arc, but the inferior accuracy attainable for longitude must depend largely on the stability of the chronometer rates. The position of the permanent camp should be made to depend for its latitude on observed altitudes of Polaris, and for its longitude in the first place on local time observations (sextant and method of equal altitudes) in combination with the rated ship's chronometers in the voyage out and again in the home run; this longitude is to be checked by a series of lunar distances; should, however, the organization of the party admit of it, observations of moon culminations are recommended, in which case a small transit would have to be provided. Should it become necessary to use an artificial horizon, as a precautionary matter in case of breakage of the level attached to the transit axis of the altazimuth (or theodolite), a black plane glass horizon with spirit level attached is preferable to a mercurial horizon.

It is desirable to insert in the record book a description of the stations, however rough or hurried, and for more important ones to accompany it by angular (theodolite) measures of surrounding distant objects, to be used for locating route lines or for topographical purposes. It is strongly recommended to mark in some way, at least the prominent magnetic stations and to give such descriptions as a party may need when endeavoring to reoccupy the stations at some future date. A small cairn placed over the station would sufficiently attract the attention.

THE MAGNETIC OBSERVATIONS PROPER.

They will comprise the measure of the three elements, the declination, the dip and the intensity which fully define the magnetic force at a place. The measures will be partly absolute, partly differential, and will be considered under two heads, viz.: those to be taken while travelling and those to be attended to at the winter quarters.

(*a*) Observations at the permanent station :

They are intended in the first place for the determination of the direction and intensity (in absolute measure) of the earth's magnetic force, also in part to elucidate the law of the diurnal variation of the declination, and secondly to supply the needful data for the conversion of the differential observations made while travelling into absolute measures. It is recommended to make regularly once each week sets of observations as follows: Hourly or bi-hourly readings of the declination magnet continued for 24 hours, beginning at midnight (local mean time) on Monday (say) and ending with the next succeeding midnight; for the purpose of determining the declination, in connection with these differential measures, the reading of the azimuth circle must be connected with the reading of the mark, the direction of which is known from astronomical observations. At some convenient hour (always the same) on Tuesdays, observe for dip (including all reversals), to be followed at once by measures of the variation of the total force by Lloyd's combination method of gravity and magnetic deflections of the dip needle. Next there will be made observations of oscillations and of deflections with the magnetometer to give the value of the horizontal component of the force (to be expressed in C. G. S. units).* The original record should be duplicated and should be absolutely free of any computation other than is needed for making the observations. The reductions should be attended to by the observer and be made in a special volume or on the blank forms usually provided. It is also desirable to test the instrumental constants as previously determined at the home station.

(*b*) Observations while travelling:

These will consist of measures of declination with a very sensitive prismatic compass or other *specially designed* instrument to allow the utmost freedom to the horizontal needle to respond to the feeble horizontal component of the earth's magnetic force. A needle delicately suspended on a single cocoon thread is known to respond to the changes of the horizontal magnetic force at places where the dip is near 89°, and may suffice even for places where θ–89½°, and probably still closer. The most delicate suspension is thought to be that of a spider thread carrying a (sewing) needle. It should be remembered that within the region under survey the diurnal variation is to be measured by degrees rather than by minutes, as in lower latitudes, and that disturbances reach over arcs covering a large part of a quadrant. There is therefore no need for great accuracy in the astronomical azimuth of the mark.

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* The observer should consult "Directions for the Measurement of Terrestrial Magnetism," Appendix No. 8, U. S. Coast and Geodetic Survey Report for 1881, also the Admiralty Manual of Scientific Enquiry, London, 1886.

The observations for dip, the most important of the survey, will be made with a Kew Dip Circle employing two needles; the usual reversals of circle, face and polarity should be attended to at each station. To place the instrument in the plane of the magnetic meridian, the usual method of finding it by means of the verticality of the needle, when in the plane of the magnetic prime vertical, it is supposed will not answer here for want of sufficient accuracy, no more than a determination of the dip by means of oscillations made in the magnetic meridian and in the magnetic prime vertical would give satisfactory results when θ> 6° (about). The direction of the magnetic meridian should, therefore, be taken as indicated by the delicately suspended needle of the declination instrument—where this method finally fails, dip observations should be made in any two planes, 90° apart, of which the first plane is preferably that of the meridian as guessed at. The circle should be of the kind supporting its needle on a horizontal bar, unless the opening through the vertical support is very much larger than usual.

The observations for intensity will be made at all stations, as far as practicable; they will consist, in the first place, of oscillations of the declination needle to be made in the ordinary way for the measure of relative horizontal intensity. These observations need not extend over more than ten minutes of time; the temperature of the magnet must be noted. The method, however, will soon become impracticable, and finally fail as we approach the higher dips. The following method has the advantage of applicability at all places, and, in particular, in high latitudes, and is, in a measure, independent of the effects of temperature of the needle; it is known as Lloyd's and consists in deflections both by gravity and by magnetic induction. For this purpose the dip circle is provided with two additional needles known as intensity-needles, the poles of which are never reversed. The small weights used as deflectors under gravity, however, are very troublesome to handle in an Arctic climate, and it is proposed to substitute for them the aluminum disk (pulley with suspended weight) of the Fox circle. Anywhere in the region the observer may also make use of the coarser method, already referred to, of oscillating the intensity-needle both in the plane of the meridian and again at right angles to it, noting also the temperature; these measures will give relative value for total and for vertical forces. The above observations for intensity are all relative and demand similar observations at the base station (winter quarters) to be made just before setting out, and again immediately after return to it, in order to furnish the data for the conversion of relative into absolute results. All intensity measures should be expressed in units of the C. G. S. system. The observer will find it desirable, if not indispensable, to train some one to assist him in recording the observations, and, in particular, for noting time during oscillations. To recapitulate respecting the proposed magnetic instrumental outfit, there will be needed :

(1) At the permanent station : an ordinary magnetometer of the Lamont, or the composite pattern of the Coast and Geodetic Survey ; if of the former, a small altazimuth instrument must accompany it ; a box chronometer and a Kew Dip Circle especially fitted for Lloyd's intensity method.

(2) While travelling : the same altazimuth and the same Kew Dip Circle, with its four needles, a specially constructed declinometer and two mean time pocket chronometers. Blank forms for recording to be carried.

It would not be advisable to charge the party with any but the absolutely necessary operations in order to secure the best attention to them, and from what has been said above, it will be apparent that much of the success of the undertaking will depend upon the skill of the observers and on their resources under the necessarily adverse circumstances under which the work is to be carried out.
C. A. SCHOTT.

Judge Daly: I have the pleasure of introducing Professor Mayer, of the Stevens Institute of Technology, Hoboken. I need not say anything about the Professor. To most of you present, he is known as one of the highest authorities on the subject of magnetism.

Professor Mayer spoke as follows:

Ladies and Gentlemen: My friend, Professor Trowbridge, has so exhausted this subject that he has left me very little to talk about. But I was asked by Judge Daly to address you and to try to excite some interest among those who knew little of magnetism—or we would suppose that they knew little of magnetism. I will try to be clear. Fontenelle said that the first evidence of politeness in one who addressed an audience was to be clear, and I shall endeavor to be polite.

I am going to take you a long way back. The remote cause of this meeting is a book published in 1600. It is a book written in Latin. In English, the title is, "On Magnetic Bodies: The Great Magnet the Earth." It was written by William Gilbert, physician in ordinary to Queen Elizabeth. Before Gilbert's day the modern method of investigating Nature was unknown. In his book, "De Magnete," Gilbert shows us by his experiments and by the way he interpreted them, how to make discoveries in physical science, thus anticipating what Bacon attempted in his over-lauded work, the "Novum Organum." Bacon thought little of Gilbert; he said Gilbert was trying to make a whole philosophy out of a magnet. Gilbert did make a whole philosophy out of a magnet. The teaching in Gilbert's book gave us the true scientific method of studying nature, and the date of its publication marks an era in the progress of knowledge. In this book Gilbert made known all the fundamental facts of magnetism. These he so arranged that they became their own interpreter and showed it highly probable that the earth itself is a great magnet.

I will explain one of Gilbert's experiments. He had several magnets made of large masses of loadstone. He had a mass formed into a sphere. Now, on putting pieces of iron to that sphere, it was very soon found out where the maximum attraction existed. These two points were diametrically opposite, and he called them the poles. He then took a magnetic needle, delicately suspended so that it could point in any direction, and moved it over the magnet. He observed that when he moved the needle over to where the iron had been most attracted, it was in a vertical direction. It was a prolongation of the axis of the sphere. He now moved the needle, and immediately it formed a smaller and smaller angle with the sphere, and when it got down to the equator it was parallel to the diameter. Then the other end of the needle dipped up until it got to the south pole when the needle again stood in line with the diameter of the sphere. If you divide that sphere, as he did, by meridians and circles of latitude, you will find, as he found, that the needle always points in a meridian; that is, it was always true north and south, and the dip increases as it goes to the pole, and at the equator it is horizontal. He called the line on the sphere where the needle was horizontal, the equator of the magnet, and where it was vertical, it marked the poles.

As I understand the words, there is a great difference between hypothesis and theory. They are constantly confounded. Buffon gave an excellent definition of these words, and that definition has been accepted in the working of scientific men. He states that hypothesis is the explanation of facts by possible causes. Theory is the explanation of facts by real causes. So theory, to a man of science, is the most certain knowledge that we have. We have theories of dynamics, of gravitation, of sound, but we have no theory of electricity or of magnetism, because these sciences consist of explanations of facts by possible causes. Now, this theory of Gilbert's was really an hypothesis. He reasoned from analogy, as all men do who investigate Nature. Twenty-five years before that, the dip had been discovered by Norman of London. Would you like to know how he found the dip? He reasoned in this way: Does the earth attract the magnet? If it is free to move, will it move toward the Magnetic Pole of the earth; does it weigh more when it is magnetized? To determine that, he weighed magnets in a delicate balance and then magnetized them and found no difference. He then put a magnet through a cork, so that it floated midway in a column of water. In one of his experiments, to his surprise, he found that it did not stay in a vertical line, but inclined to the horizon and dipped. He then made what was called the dipping needle, which is substantially the same instrument as will be used in this expedition.

Now, Gilbert's hypothesis was proved by Hudson, in 1608, who discovered, in latitude 75° 22′, the dip of the needle to be 89° 30′, as Gilbert had predicted. The variation of the needle was known to navigators before Columbus's first voyage to America. Gilbert's hypothesis did not account for the variation. Then it was assumed that the Magnetic Pole did not correspond with the exact Pole. The Magnetic Pole does not correspond with the geographical Pole. Suppose it is 20° south of it, as it is, then it is very evident that if you are right south of the Pole, the needle will point north. There will be no variation on that meridian. As you go east of south, the needle will evidently point to the west, and as you go west of south it will point to the east. Therefore, on one hemisphere it will have a westerly and on the other hemisphere it will have an easterly movement. Halley, a contemporary and friend of Newton, during a voyage sent out by the English government, found out, when he came home and discussed his observations, that the variations he observed could only be explained by assuming four magnetic poles, two in the northern hemisphere and two in the southern. That is the origin of the idea of the two magnetic poles in the northern hemisphere and two in the southern. Gauss takes up that idea of magnetism and magnetic forces in his masterful work on terrestrial magnetism. This is not a theory of magnetism, because we do not know anything about the agents acting here and we cannot predict what will happen at some distant period.

Now we come to this subject of four magnetic poles. Halley had no means of measuring the magnetic intensity. It was not measured in his time. But now we know that there are four regions of magnetic intensity. The strongest is in the northern region, between Lake Superior and Hudson Bay. There is another in the northern hemisphere from the Lena

River to the west. There are two other foci of strong magnetism in the southern hemisphere. They are close together. They are between Australia and the Antarctic Continent. Assume that those centres of force have been determined by observation. Since the time of Halley, observers all over the world have made observations of the condition of magnetism of the earth. We find that there are four lines of no variation, as there should be; or there are, rather, two lines and then an oval, which makes two more lines. These facts formed the basis of Halley's hypothesis of two poles in each hemisphere; then, as you divide the earth into four parts, the opposite sections of the earth will be, east declination to the west, and to the west will be east. That is what you find as you go around the earth. You find those four variations of east, west; west, east.

You have come here to listen to some talk about this expedition to find out the North Magnetic Pole. What is your idea of a magnetic pole? It is not the area of maximum force. In the case of a long hard steel magnet, the pole would correspond with the maximum force. The magnetic lines of the earth are constantly fluctuating. The magnetic equator does not follow the terrestrial equator. The lines of variation are very irregular, converging, however, to two magnetic poles. We can tell the position of the Pole by the attraction. What we want to find is what we call the verticity of magnetism. That is, where the dipping of the needle will be vertical. That is the point we wish to determine: where the magnetism of the earth will so act on the needle that it will point in a vertical direction. James Ross got an approximate verticity at this point. I will recall to you some historical facts. In 1580 the declination, the variations, of the needle in London were observed to be about 11°. In 1600, in the time of Gilbert, it was about 8°. In 1657, the needle pointed north. You see it had moved from the east. It then began to move to the west, and moved to the west for 161 years, until 1818, when it had moved 24¾ to the west of the meridian. That was the variation in London. Then it came back, and from 1818 to 1892 it has moved from 24¾ west to about 17¾ west. Now, observe this great cycle. In 161 years it has moved from its meridian to its extreme westerly swing; now it is coming back again. It has gone from its extreme swing back one quarter. In the remaining number of years will it come back? Now, what are the causes of that? That is what we are trying to find out. As Professor Trowbridge has stated, there have been various hypotheses as to those lines of variation on the earth's surface. One is that the Magnetic Pole is in motion. It is deep down in the earth, and that pole is moving, and it is very evident that if you were to take a magnetic needle and then have another powerful magnet off at some distance, that you could deflect the magnetic needle by moving the large magnet. We want to know, does it move; has it moved? Does that pole move to and fro in a line straight or curved, or does it move in an orbit? We wish to see an American expedition go to the North Pole to make an observation on a point of that orbit, if it be an orbit. It may be a fixed pole, not a planetary pole. What has been done? Science has determined one of the points of that orbit—only one orbit. Americans wish to determine another point. Subsequent observers fifty years hence, when we are all gone, will make another observation, and so they will go on; and in the course of time, it may take three centuries, the motion of that pole, if it has a motion, will be determined. I do not know of any object in science more interesting than the object of this expedition. We can do it. Americans should do it. They should plant the American flag on the North Magnetic Pole. We do not go up there to find some passage. We know what we are to find. It has all been planned out by one of the most eminent magnetists of the world, Professor Schott. From his study of observations taken all over the world he knows exactly what is to be done. There is no doubt that this expedition, if organized, will reach the North Magnetic Pole and will show whether that Pole is a fixed pole or a planetary one.

Judge Daly: It affords me very great pleasure to introduce General Greely.

General Greely spoke as follows:

Ladies and Gentlemen: It is with a peculiar feeling that I speak again in Chickering Hall and to the Fellows of the American Geographical Society and their friends. Some seven or eight years ago such a cordial and enthusiastic reception was given me here as must always abide in my mind. It was well and truly said to me then, by an American, that that homage, whether due or not, paid to me by my fellowcountrymen, by the representative Geographical Society of this country, would give me greater pleasure, far, than any honors which might come to me, as they have since come, in other lands. And so I always have had, and always shall have until my dying day, a great affection for the American Geographical Society, and a kindly feeling for Chickering Hall.

But I came here to-night, not for reminiscences, but to speak concerning the proposed expedition for the magnetic survey of King William's Land, which Colonel Gilder proposes to lead, and which I hope will be sent forth by American money and under American men. The spirit of unrest has well been outlined in that wonderful description of Ulysses,

> "I cannot rest from travel . . .
> . . . my purpose holds
> To sail beyond the sunset, and the paths
> Of all the western stars, until I die."

And when a man seeks to travel, to pass out between the Pillars of Hercules into the unknown regions, we know that, in that respect, he shows himself like to his fellow-kind. But, when we get beyond the general principle, we find some special reason which causes each man to travel, something that impels, which turns him in that special direction. You have not far to go to find the impulse which, I hope, will send Colonel Gilder north again, because it turns back a leaf in his own history, but still more leaves in the history of the English-speaking race.

Those who have crossed the ocean, who have passed into the great Westminster Abbey, have read there, if they chose, or if they took an interest, upon a white slab a verse of Tennyson's; it reads:

> "Not here; the white North has thy bones; and thou,
> Heroic sailor soul,
> Art passing on thine happier voyage now
> Toward no earthly pole."

It is a tribute of the Poet Laureate to Franklin, a man who, in his work, represented the remarkable spirit of investigation which has characterized England, and which has made it the country it is. The story of that expedition is not to be told here. I will allude briefly only to the last days of it and to the wonderful march, which—after Franklin had died and had been committed to the icy deep he had sought in the last years of his life—those men made down the west coast of King William's Land. The tribute paid to these men is, to my mind, one of the highest tributes ever paid to the firmness, the resolution, the courage, great as these are, of the Anglo-Saxon race. When, in later years, there were found some Eskimo who had seen some of the Franklin crew, they told in these touching words the history of that march: "As they walked along, they fell down and died." These men died in action, as the best and bravest of the Anglo-Saxon race have so often died, and such action has given life to the maxim that "He dies best who dies by use and not by rust."

In regard to expeditions of this kind, there are three points concerning which an American public ask information: (1) For what good? (2) Is it practicable? (3) (Especially in connection with Arctic expeditions) Is it safe?

Concerning the desirability, the scientific experts have spoken with such force that none, I think, can doubt their truth. Although not, perhaps, what you might call a scientific man, yet I may add a little to what they have said upon that point. In my journey north, some nine hundred miles (statute miles), to the north of the Magnetic Pole, in settling upon the east coast of Grinnell Land to do the scientific work which I was charged with, I made a great sacrifice to my feelings of ambition for geographical work, because if I had landed upon the Greenland side, I would have been able to have gone not only to the farthest north of that time, but many and many a mile beyond. However, I bore in mind the necessity of uniting my scientific work with others, and so, reluctantly, very much to the detriment of my geographical work, I landed on the west shore. The observations made by me there, in conjunction with those of the English expedition some seven or eight years before, were the first observations which enabled experts, through Professor Schott, the chief among them all, who has been alluded to here to-night, to determine the annual secular variations of the magnetic needle in Smith Sound. It was further found that the average annual diminution of the dip, already fixed at 1″, was now changed to an average annual increase of 1.5″. So this much was added to our knowledge by these observations.

Wherefore do we speak of this work as being so important? The relation of magnetism to the other branches of physical science is becoming more and more evident, and it was with a feeling of especial pleasure, when I attended the final meeting of the International Polar Commission at Munich last September, that I presented to it the hypothesis of Professor Bigelow, in which he pointed out what he thought to be the evidences showing the inter-relation between magnetism and meteorology. One of the most distinguished of German philosophers and scientists, Dr. Neumayer, agreed with another of the most distinguished of the French, Professor Mascart, that this did bear out part of Gauss's theory. It is conceded that we may hopefully seek a solution for many of the important points, now doubtful and obscure in physical sciences, in more accurate magnetic observations, and in the discussion of the mass which we have already collected.

Passing on to the point as to whether this work is practicable, I can simply say that no doubt can exist if we base our opinion—as we must base it—upon what has been done in the past. Taking the great circle which is outlined here around King William's Land (indicated on the map), it is evident to all having a thorough knowledge of Arctic history that this portion of the Arctic regions has been visited more frequently, and with less danger and less loss of life, than any other within the Arctic Circle. We have the five years of Ross, from 1829 to 1834; we have the work of Parry, Lyon, and Allan Young's voyage later into Bellot Strait. Again, an American, Hall, lived five years in this country. To the west, the remarkable voyage of Collinson, extending very nearly into Victoria Strait. Then, again, the last voyage of McClintock, in which he succeeded in reaching King William's Land. Again, two or three winters of Rae, at Repulse Bay, where this expedition proposes to have its headquarters. Back, King and Anderson made voyages down the Great Fish River, and then, after all, the very remarkable and extraordinary journey of Schwatka and Gilder, a journey which, I may safely say, will link their names with English history as long as the walls of Westminster Abbey shall stand, and as long as that stanza of Tennyson's shall be engraved upon its marble slab.

All these expeditions which I have mentioned approached King William's Land either from the west or the east or the south. One expedition only, the fatal one of Franklin, came from the north. That expedition was not one attempting to hold to land, as all these other expeditions did, but one venturing into the ice pack for the discovery of the North-West Passage, and from that, and the further fact that those vessels were dependent on sail power, may be attributed the fatal outcome of the voyage of Franklin. In connection with the expeditions that have entered this region since that time, the fatality resulting therefrom has been no greater than would occur among the same number of men of the same age, living for the same length of time in New York City. As for the safety of this expedition, having, as it will, a land base at Repulse Bay, and going overland to the strait separating it from King William's Land, it will pass over a country thoroughly familiar to Colonel Gilder, quite thickly peopled with natives, and covered for the greater part of the time with game.

There is no doubt that such an expedition is desirable, is practicable, and is safe. I shall be gratified if any word that I have said here to-night, any opinion which I have expressed, shall induce any hearer to give substantial aid for this expedition. I think that any contributor will be doing a service to his country in insisting that this important work, so promising for science, shall be done by Americans and under an American, with that spirit of resolution, of courage, and of enterprise which have made the United States of America the greatest of all civilized nations.

Judge Daly:

Ladies and Gentlemen: We are now about to close, but before we depart, I will introduce Colonel Gilder. He is not a speaker, but probably you would like to see him.

Colonel Gilder spoke as follows:

Ladies and Gentlemen: I do not see that there is anything left for me to say. You have had the scientific features of the proposed expedition presented to you by people who understand the matter, and General Greely has spoken from his own experience of Arctic work, and from what he knows from reading. He has expressed his opinion of its practicability, so I do not see that there is anything for me to add.

I might say, however, that the Committee of the National Academy of Sciences had some hesitation to recommend this work, fearing that the Pole might be found over the water, which you see on the map, but that is no impediment to travel there, because it is filled with ice about twenty feet thick, as I found it when I was there a few years ago. Therefore there is no trouble whatever in travelling anywhere there with sleds. The only difficulty might be that, in following Professor Schott's recommendation that we should leave a cairn to mark the spot where we found the pole of verticity, the ice movement might carry that cairn out of the way, and under such circumstances a re-visit would not be so valuable. But the plan of survey comprehends a surrounding of the Magnetic Pole, and in that way we will always be able to find the point again.

I propose to make Repulse Bay the position of a permanent station. It is the nearest point to the Pole of Ross that can be easily and safely reached by ship, and lies only about three hundred miles from it, in a direct line of overland journey that has been traversed a number of times. It has been crossed by Rae and by Captain Hall, and to the west of that by Lieutenant Schwatka and myself, and by several others. It seems the most practicable route to the pole-containing area.

The strait between the Pole of Ross and King William's Land was crossed at the time that Ross established the pole. He crossed to King William's Land and went several miles down the coast to the point he named Victory Point, where he left a cairn. Afterward when McClintock wintered in Bellot Straits in 1858–59, he and Lieutenant Hobson, his first officer, came down this coast in the spring and crossed over to King William's Land. Hobson went down the west coast and McClintock went by the east coast to Montreal Island. Hobson in going past Victory Point found the only record that has ever been found of the Franklin expedition. That is a record that was left first by Lieutenant Gore and de Vaux and afterward it was written on by Captain James Fitzjames, who landed there with the survivors of the Franklin expedition under Captain Crozier. After leaving Victory Point, Hobson journeyed on down the coast and got as far as Cape Herschel on the south side, and a little beyond that, where he left a cairn with a memorandum in it for McClintock, who was to come up that way on his return to the ship.

When McClintock found this record of Hobson's, in which he stated that he had found the Franklin record and had to return to his ships, being pretty well used up with scurvy, McClintock followed him up and left his record in place of the one left by Hobson. That is the record Lieutenant Schwatka and I brought home after leaving a copy of it there with our own.

Victoria Strait, on the west, was crossed by Rae, and by Collinson, and there is no trouble whatever in making the journey. I won't say that there is no trouble, but it is not impossible by any means; it is merely rough ice travelling.

It is practicable, and if it is practicable, it is a work that ought to be done.